

America Makes – The National Additive Manufacturing Innovation Institute Update

The National Accelerator for Additive Manufacturing

MBE Summit 2016

Ed Morris

*NCDMM Vice President and
America Makes Director
330-301-7963
Ed.Morris@NCDMM.org*

April 14, 2016

ASTM Definitions of Seven Main Categories of Additive Manufacturing Processes

Process Type	Method	Materials	Market
Powder Bed Fusion	Thermal energy (laser or electron beam) selectively fuses regions of a powder bed	Metals, Polymers	Manufacturing, Prototyping
Directed Energy Deposition	Focused thermal energy (laser or electron beam) is used to fuse materials as deposited	Metals	Manufacturing, Repair
Material Extrusion	Material is selectively dispensed through a nozzle and material laid down in layers	Polymers, food	Manufacturing, Prototyping
Vat Photopolymerization	Liquid photopolymer in a vat is selectively cured by light-activated polymerization	Photopolymers	Prototyping
Binder Jetting	Liquid bonding agent is selectively deposited to join powder materials	Polymers, Sand, Metals, Ceramics	Prototyping, Casting Molds, Manufacturing
Material Jetting	Droplets of build material are selectively deposited, “ink-jet printer” like	Polymers, Waxes, tissue, metals (electronics)	Prototyping, Casting Patterns
Sheet Lamination	Sheets of material are bonded to form an object	Paper, Metals	Prototyping, Manufacturing

Why, How, What

AMERICA MAKES

WHY

The U.S. is not doing well in the Global Economy, and needs a reinvigorated Manufacturing Sector that includes a strong Defense Industrial Base.

HOW

Transform manufacturing in the U.S. through innovative, coordinated Additive Manufacturing Technology Development, Technology Transition, and Workforce & Educational Outreach.

WHAT

Accelerated adoption of additive manufacturing technologies in the U.S. manufacturing sector that yield innovative products and increased domestic manufacturing competitiveness.



**Collaborate
Cooperate
Innovate**

Who We Are



America Makes is a public/private partnership with substantial federal, private industry, and academic investment

The partnership is a multi-agency collaboration between industry, government and universities, led by the Defense-wide Manufacturing S&T team

We have an innovation facility in Youngstown, Ohio

We have 171 members and continue to grow

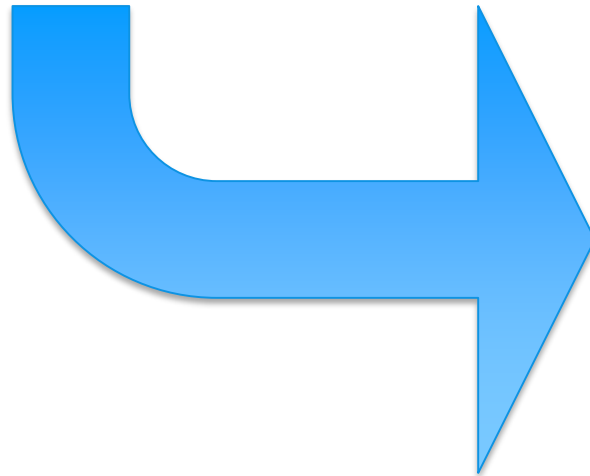
We are operated by the National Center for Defense Manufacturing & Machining (NCDMM)

Membership Growth

171 America Makes Members as of 4/12/16

20 Platinum Members
51 Gold Members
100 Silver Members

**15 New Member
Requests Being
Processed**



108 Industry Partners
(61 Are Small Businesses)
37 Academic Partners
13 Government Partners
10 Non-Profit Organizations
**3 Manufacturing Extension
Partnerships (MEPs)**

42% Average Annual Membership Growth Rate in 2014 & 2015

Delivering Value

- Robust Additive Manufacturing Roadmapping
- Opportunity to Participate in Funded Projects
 - Consortium-driven Project Calls
 - Agency-driven Projects
 - Member-driven Projects
 - Client-driven Projects
 - Competitively-awarded Projects
 - Crowd-sourced Projects
- Access to Consortium Developed IP
- Use of the America Makes Innovation Factory



With our March 2016 Project Call, America Makes will have a portfolio of more than \$96 million in public and private funds invested in advancing the state-of-the-art in AM in the United States.

America Makes Technology Roadmap – Level 1

2014

2015

2016

2017

2018

“Gray Space” with < 5 CTE Maturation Ideas

Design

Product & Process Design Aides/Apps

Cost & Energy Driver Analysis/Modeling

Bio-Inspired Design & Manufacturing

Material

“Non Ad-Hoc” Additive Manufacturing Tech Data Packages

Material Property Characterization

Next-Gen Materials

Process

Multi-Material Delivery & Deposition Systems

Next-Gen Machines

Process Temp Gradient Control

Value Chain

Standards/Schemas/Protocols

Rapid Inspection Technologies

Advanced Sensing and Detection Methods

Repair Technologies

Intelligent Machine Control Methods

Digital Thread Integration

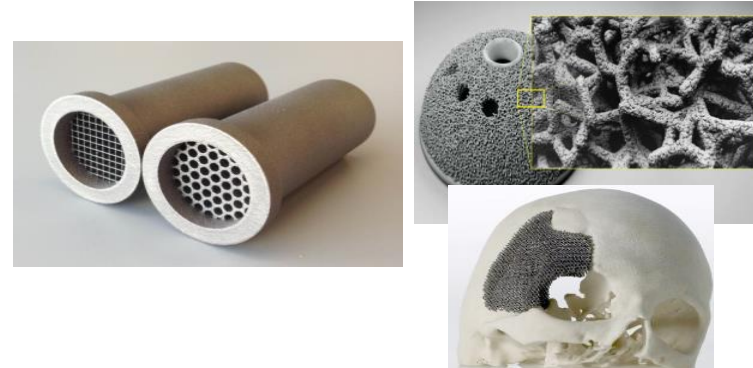
AM Genome

Benchmark Validation Use Cases

Physics-Based Modeling & Simulation

Model Assisted Property Prediction

Developing Topology Optimization Tools that Enable Efficient Design of Additive Manufactured Cellular Structures



Objectives:

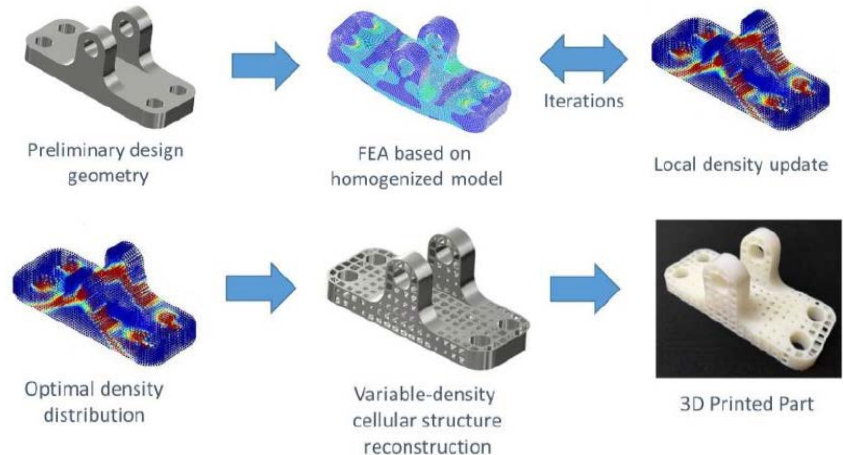
- Develop experimentally-validated micromechanics models, topology optimization, and reconstruction algorithms for different cellular structures.
- Demonstrate and validate capability of design and optimization tools on design of a realistic structural component

Goals & Benefits:

- Enable efficient design of cellular structures in load-bearing parts for Defense Wide applications
- ANSYS infrastructure already in place to commercialize the optimization technology

Performers: University of Pittsburgh, Acutec Precision Machining, Alcoa, ANSYS, ExOne

Integrated Design Tool Development for High Potential Additive Manufacturing Applications



Objective: Develop an integrated design suite with built-in design aids for various AM manufacturability requirements and new topology optimization capabilities for high potential additive manufacturing applications

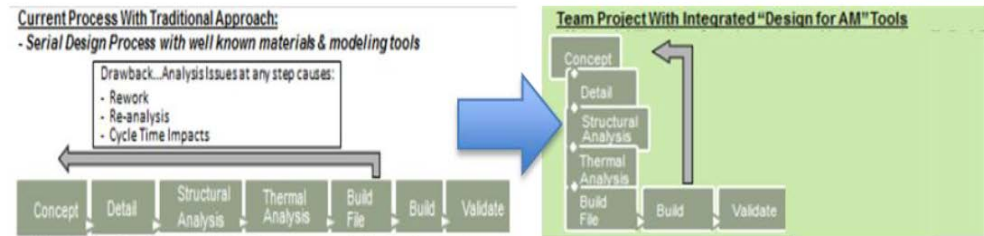
Goals & Benefits:

- Integrated design suite will help minimize time of the design phase, lower manufacturing cost, and reduce time to market for new AM product development
- ANSYS will implement this technology into the Topo Opt module and SpaceClaim module of its software

Performers: University of Pittsburgh, ANSYS, UTRC, Honeywell, Material Science Corp., Aerotech, ExOne, EOS, RTI International Metals, AMRDEC

Multidisciplinary Design Analysis for Seamless AM Design, Analysis, Build, and Redesign Workflows

Move from a serial process of islands of sub-optimization...



...to an integrated rule-based environment

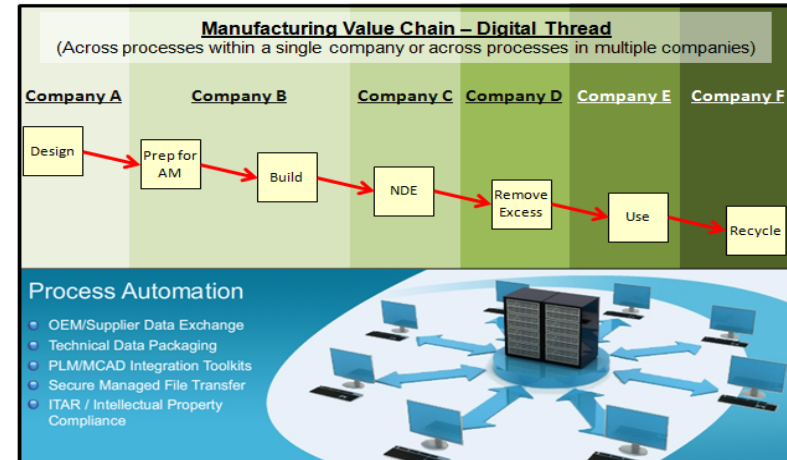
Objective: Deliver demonstration models, training, rule sets and design flows

Goals & Benefits:

- Development of design for manufacturing rule sets to exploit Additive Manufacturing benefits and improve design to build flow
- Exploit market reach of team participants to transition design rules and improve multi-platform results
- Pervasive impact to industry and membership
 - Improve design to build cycle time
 - Integration of multi materials/properties
 - Simultaneous trades for performance

Performers: Raytheon, GE, University of Wisconsin, University of Massachusetts Lowell Research Institute, Netfabb, ANSYS, Altair, Autodesk, Materialise

Digital Threading of Additive Manufacturing



Objective: Demonstrate how modification of STL information will reduce material consumption, processing time, and post process finishing time, resulting in shorter cycle times and reduced lifecycle cost (material, time, and energy)

Goals and Benefits:

- Enable an art-to-part integrated process, tools, and digital thread to reduce cost, cycle time, and time to market by minimizing material deposition, component finishing processes and the application of automation between process step.
- ITI and Stratonics will provide the results of this project as part of standard product and service offerings.

Performers: Boeing, ITI, Stratonics, Aerojet, Raytheon, U. of Tennessee

Automatic Finishing of Metal Additive Manufactured Parts to Achieve Required Tolerances and Surface Finishes



Objective: Develop an integrated software solution that will create an automatic hybrid system that can deliver direct metal parts with required tolerances and surface finish

Goals and Benefits: Reduction of cost for use of additively manufactured parts for maintenance and sustainment efforts

Performers: North Carolina State U., CalRAM, Advanced Machining, FineLine Prototyping, Iowa State U., John Deere, Kennametal, Productivity Inc.

America Makes Advisory Group and Working Groups for *Additive Manufacturing Standards, Specs, and Schemas Coordination*

Additive Manufacturing Standards, Specs, and Schemas Advisory Group

- **Purpose:** Coordinate, prioritize, and accelerate the development and availability of additive manufacturing standards, specs, and data schemas
- **Membership:** Cross-section of America Makes Members and Government stakeholders

America Makes & ANSI Additive Manufacturing Standardization Collaborative

- **Purpose:** Coordinate and accelerate the development of government and industry-wide additive manufacturing standards and specifications
- **Membership:** America Makes Members and Non-Member Stakeholders

Additive Manufacturing Data Schemas Coordination Working Group

- **Purpose:** Establish industry-wide data schemas and templates for additive manufacturing and accelerate their use
- **Membership:** America Makes Members and Non-Member Stakeholders

Additive Manufacturing Standards, Specs, and Schemas Advisory Group Charter

Purpose:

The Purpose of the Additive Manufacturing Standards, Specs, and Schemas Advisory Group (AM3S AG) is to lead America Makes' efforts to coordinate, accelerate, and prioritize the development and availability of additive manufacturing standards, specs, and data schemas for use by government and industry in the United States.

Objectives:

- Provide advice to America Makes leadership and members regarding the coordination of standards, specs, and data schemas that meet the needs of the additive manufacturing community
- Develop and implement sound technical approaches to accelerate the development and availability of additive manufacturing standards, specs, and data schemas for the user community

Advisory Group Members:

- | | |
|-----------------------------|--------------------------------------|
| • Todd Rockstroh – Industry | • LT James Coburn - FDA |
| • Kevin Jurrens – NIST | • Rich Martukanitz – Academia |
| • Greg Saunders – DoD | • Jim McCabe – ANSI |
| • Blake Marshall – DoE | • Jim Williams – Working Group Chair |
| • Doug Wells – NASA | • Jesse Boyer – Working Group Chair |
| • Michael Gorelik – FAA | • Kevin Creehan – America Makes |

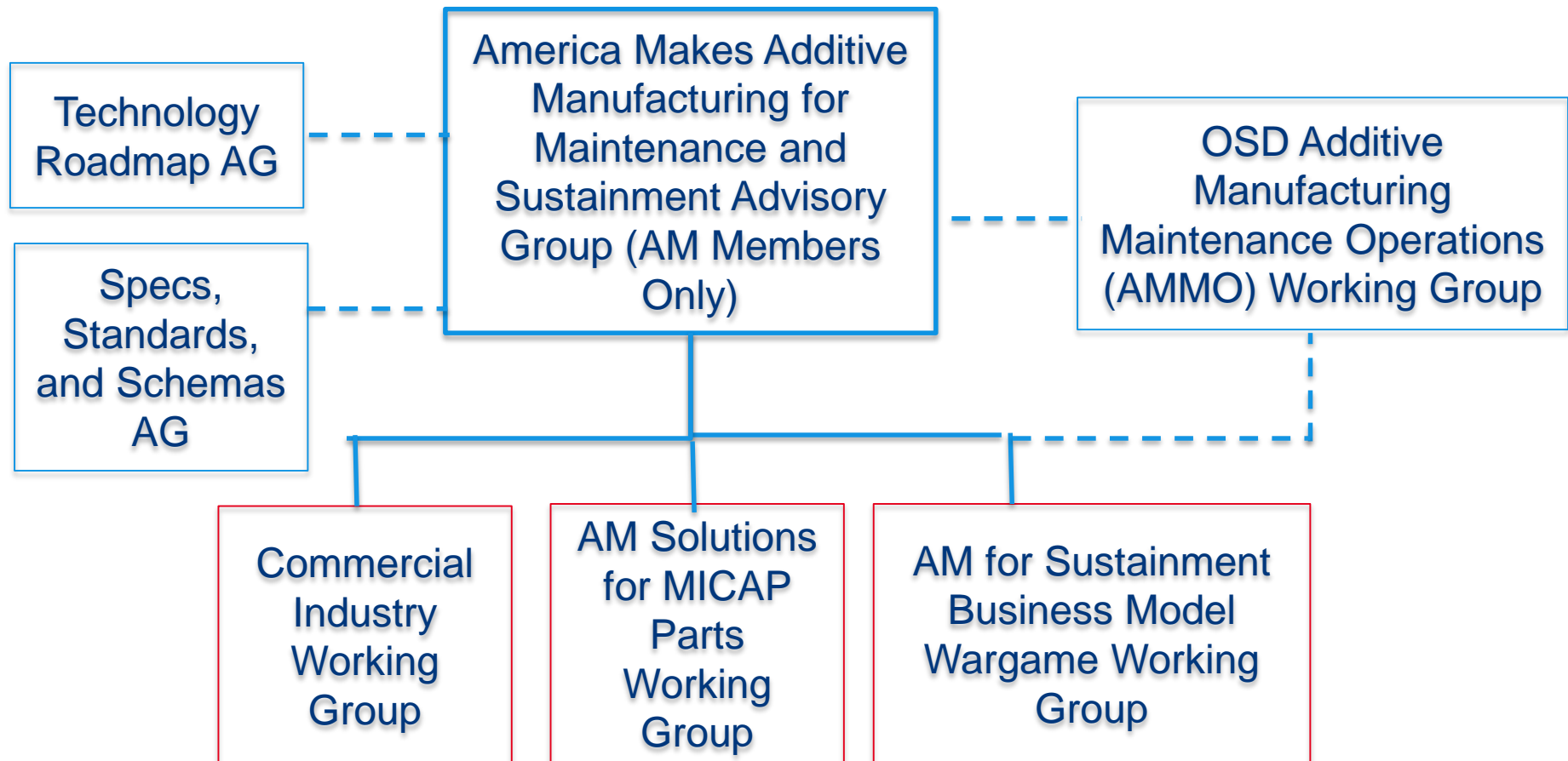
ANSI Panels/Collaboratives & Workshops

- Provide a neutral forum to address topical issues of national importance
- Convene all materially affected and interested parties in an environment that respects the principles of openness, balance and consensus
- Prioritize needs in relation to standards and conformity assessment programs
- Identify and catalog existing standards and standards under development
- Define gaps
- Develop recommendations for work to be undertaken by standards developers
- Other activities as needed, e.g., topical workshops

America Makes & ANSI Additive Manufacturing Standardization Collaborative (AMSC) Working Groups (WGs) and Co-Chairs

- **Design WG Co-chairs:** John Schmelzle (NAVAIR) and TBD
- **Process and Materials WG Co-chairs:** Todd Rockstroh (GE Aviation) and Art Kracke (AAK Consulting LLC)
 - 4 Subgroups (SG): Precursor Materials, Process Control, Post-Processing, Finished Materials
- **Qualification & Certification (Q&C) Co-chairs:** Armen Kurdian (U.S. Navy) and TBD
- **Maintenance WG Co-chairs:** David Coyle (NAVSUP WSS) and Michele Hanna (Lockheed Martin)

Additive Manufacturing for Maintenance and Sustainment Advisory Group (AG)



Additive Manufacturing (AM) Business Model Wargame

Understanding the Commercial Considerations

Dates: 9-10 May 2016

**Location: Lockheed Martin Corporation – Center for Innovation
8000 Harbor View Blvd, Suffolk Virginia 23435**

The Simulation at a Glance: The intent of the wargame is to illuminate the required business transactions when the DoD requires critical and non-critical parts be additively manufactured at a DoD depot location or at a 3rd party location in support of an immediate readiness goal. The wargame will also include assessing commercial gaps and challenges that may be discovered during this simulation in order to begin developing the necessary environment to support the continued adoption of Additive Manufacturing (AM) capabilities.

Outcomes: The wargame exercise will identify issue sets, frame up potential solutions, test government and industry readiness to exercise solutions, and provide next steps for further consideration.

Game Move One: RFP Release and Reaction

	Government Team	Industry Teams
12:00 to 1:00	Lunch/Networking and Game Kick Off	
1:00 to 3:00	Government Team: Formulate Requirements, Draft and release RFP Industry Teams: Formulate Questions and Proposal Strategy	
3:00 to 5:00	Government Team: Holds Individual Meetings, Develop Evaluation Criteria Industry Teams: Develop proposal briefings, including pricing	
5:00 to 5:30	Move One Closing Comments	
5:30 to 6:30	Networking Reception	
7:00 to ?	Game Facilitators Prep for Day Two	

Government Team

This team will run the scenario with both Industry teams working both RFPs.
This will identify contracting and procurement issues on the Government side in both RFP scenarios

Industry Team 1

This team will run the scenario reacting to RFP 1. This will illuminate the issues, risks, and solutions around the Government procuring IP for organic or 3rd party AM.

Industry Team 2

Will run the scenario Reacting to RFP 2. This will address the problem sets surrounding a Government ask for the OEM, direct competitors, or AM focused 3rd parties to maintain control of the IP in a critical need situation.

Game Move Two : RFP Release and Reaction

	Government Team	Industry Teams
9:00 to 10:00	Government Team: Reviews Proposals Industry Teams: Brief proposals and then consider negotiating strategies	
10:00 to 12:00	Government Team: Evaluate and Conduct second meeting as necessary Industry Team: Revise proposals as required	
12:00 to 1:00	Move Two Closing Comments, Lunch, & Networking	

Government Team	Industry Team 1	Industry Team 2
<p>This team will run the scenario with both Industry teams working both RFPs.</p> <p>This will identify contracting and procurement issues on the Government side in both RFP scenarios</p>	<p>This team will run the scenario reacting to RFP 1. This will illuminate the issues, risks, and solutions around the Government procuring IP for organic or 3rd party AM.</p>	<p>Will run the scenario Reacting to RFP 2. This will address the problem sets surrounding a Government ask for the OEM, direct competitors, or AM focused 3rd parties to maintain control of the IP in a critical need situation.</p>

Roles – Who We Need and Why

Function	What do they do?	Why should we include them?
Government		
Procurement & Contracting	<ul style="list-style-type: none"> Evaluate responses to RFPs and structure contracts 	<ul style="list-style-type: none"> Provide insight into the procurement of specific technology and equipment
Budgeting & Finance	<ul style="list-style-type: none"> Provide funding for contracts that maintain the supply chain 	<ul style="list-style-type: none"> Provide insight into government budgetary constraints and regulation
Mission Support	<ul style="list-style-type: none"> Plan for and acquire parts for mission critical maintenance 	<ul style="list-style-type: none"> Possess on-the-ground experience interacting with mission critical supply chain
Supply Chain Management	<ul style="list-style-type: none"> Manage the sourcing and procurement of mission critical parts 	<ul style="list-style-type: none"> Understand the procedures around last-minute requests for mission critical parts
Policy Officer	<ul style="list-style-type: none"> Assigns responsibilities, and provides procedures governing DoD policy 	<ul style="list-style-type: none"> Provide expertise as it pertains to oversight, compliance, and DoD policies
Industry		
Sales & Contracts Management	<ul style="list-style-type: none"> Manage responses to RFPs and maintain existing contracts 	<ul style="list-style-type: none"> Provide insight into what incentivizes industry partners to respond to government RFPs
Intellectual Property & Legal	<ul style="list-style-type: none"> Manage intellectual property rights and patents for the company 	<ul style="list-style-type: none"> Demonstrate the legal implications of sharing IP with government or 3rd parties
Supply Chain & Manufacturing Ops	<ul style="list-style-type: none"> Manage demand planning and manufacturing of mission critical parts 	<ul style="list-style-type: none"> Determine the approach for manufacturing and stocking ideal quantities of parts

When America Makes America Works

